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Micromorphic theory of multiphase immiscible mixtures WEIMING LI, SAMUEL PAOLUCCI, University of Notre Dame — We consider a general multiphase immiscible mixture whose individual components are separated by infinitesimally thin interfaces. General average balance equations for the different phases as well as for the overall mixture are derived by using a systematic spatial averaging procedure. To account for local micro-motions and micro-deformations, we model the mixture using micromorphic theory. A minimal determinate theory is obtained by taking an appropriate number of moments of the microelement balance equations for mass, momentum and energy, together with the production of entropy inequality. The resulting average balance equations include equations for microinertia and microspin tensors. These equations, together with appropriate constitutive equations consistent with the entropy inequality, enable the modeling of immiscible multiphase materials where internal field quantities, such as the volume fraction of different phases, are important. To demonstrate the generality of the results, we apply it to a bubbly fluid. We show that the equations for microspin and microinertia, under a number of simplifying assumptions, combine to yield a general form of the Rayleigh-Plesset equation. Such an equation, in addition to accounting for the local average bubble microstretch (expansion or contration), also accounts for the local average bubble microrotation. Moreover, it contains higher-order microstructural statistics which in this minimal theory can be modeled by a constitutive approximation.

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